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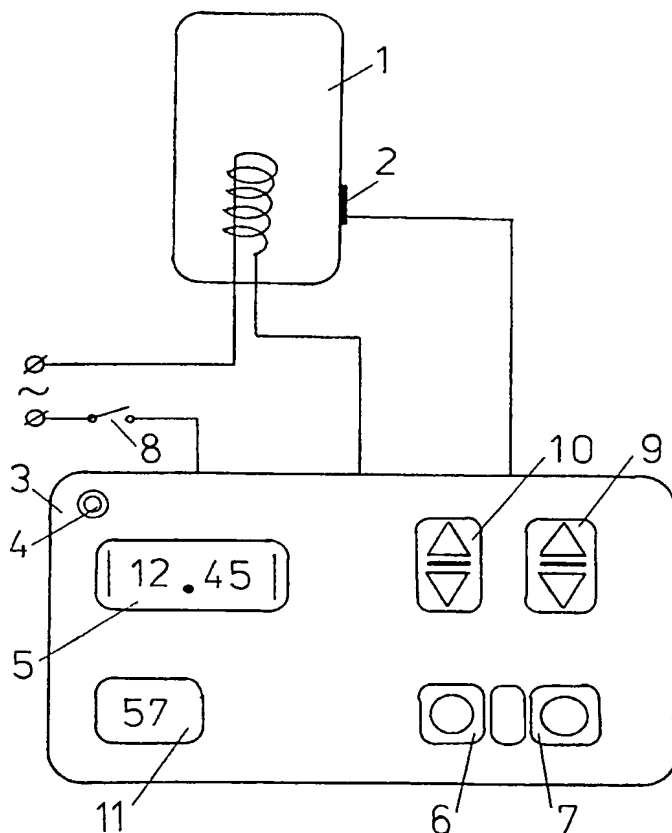
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(54) Title: **ELECTRIC STORAGE BOILERS CONTROL ENABLING DELAYED CHARGING**



(57) Abstract: The method can be applied in all the standard volumetric storage electric boilers, as it enables the most efficient usage of stored energy. The current control methods foresee the start of the heating process (storage) immediately after turning on and applying voltage to the boiler and to finish in a moment of reaching the maximum temperature defined by its thermal controller. Considerable disadvantage in the case is that between this time and period of hot water consumption there is a long time period usually, when the boiler: (a) - operates in ON/OFF mode, leading to accelerating damaging the thermal controller; (b) radiates irreparably energy in environment; (c) loading useless the energy system. The proposed method resolves these problems as enables the boiler to operate in delay mode, i.e., the heating process to be shifted in time in such manner that one to be independent on the switching on time and to finish in time when the hot water consumption is expected.

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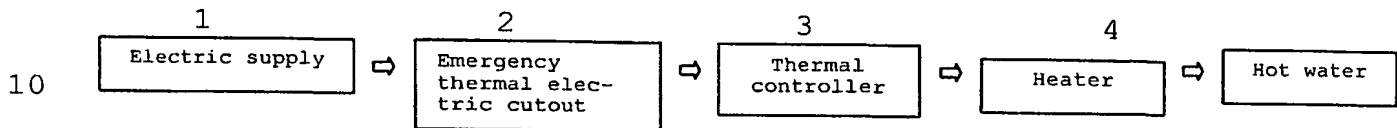
## ELECTRIC STORAGE BOILERS CONTROL ENABLING DELAYED CHARGING

TECHNICAL FIELD OF THE INVENTION.

The fields of application of this method are the volumetric storage electric boiler production and consumption.

BACKGROUND OF THE INVENTION

The high-capacity storage electric boilers produced and offered on our and abroad market, have the following principal functional block-scheme:



The method applied to control their operation is based on the Heater (4) built-in in their structure, heating the water up to desired temperature and powered by electric main through in serial connected a Thermal electric cutout (2) and a Thermal controller (3). The heating process starts in  $T_1$  time (Fig.1) in current water temperature  $t_t$ , coincident with  $T_2$  boiler switch on time and lengthens up to reaching maximum water temperature  $t_m$ , adjusted by means of the thermal controller. The line "a" is the theoretical heating curve with no thermal losses, and the line "b" is the real curve accounting the thermal losses. The  $S_1$  areas are the thermal losses for the  $T_1$ - $T_p$  period.  $T_p$  - a time of hot water consumption. Duration of the heating process is variable and it depends on: the heater power; the water temperature within the reservoir in initial heating time; boiler thermal isolating properties; ambient temperature;

On reaching water temperature, defined by the thermal controller, one cuts out the electric power. If after that there is

not water consumption from the boiler, a period of lengthening thermal radiating follows and as a result of that the water temperature starts to diminish - the curve "c". Duration of this process depends on the boiler thermal isolating properties, ambient temperature and the thermal controller hysteresis characteristics and it continues up to  $T_4$  time where the thermal controller turns on the electric power and a new heating cycle begins - the curve "d", etc. This operation "ON-OFF mode" is valid up to hot water consumption starting time  $T_p$  or up to switching power off by the boiler switch. It is very typical for the period from 22.0 to 06.00 o'clock of 24-hour day/night cycle, where the advantage of cheaper night electric power is applied, as also for periods, when the turning off heater by the thermal controller goes before starting the hot water consumption time, for instance, when the boiler is being switched on in beginning work time, in order to heat water and then the heated hot water to be consummated immediately after closing work day;

The electric boiler operation in ON/OFF mode posses the following negative sides:

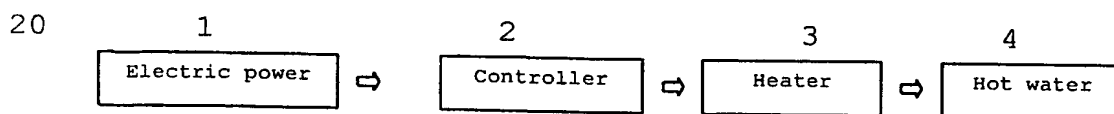
- a) irreparable energy loss - the thermal radiation in environment is to the highest degree because of water temperature is held up by the thermal controller to values, close to the maximum and in a period when hot water isn't consumed;
- b) the frequent and unbroken for long periods thermal controller turns on/off damage it quickly too (whereupon cases of boiler explosions are recorded) and the repair-to-repair periods are shorted;
- c) starting boiler operation more before period where the hot water would be consumed.

SUMMARY OF THE INVENTION

The essence of the proposal is consist in that to propose a new method controlling volumetric electric storage boilers operation enabling them to operate in delaying mode. The method is based on the possibility the heating process to be shifted in time in such manner that heating to be independent on switching on time and to finish in time when starting heat water consumption is expected. For implementing this method a controller unit is added-in into the boiler design, which enables:

- to watch in-boiler water current temperature in continuous mode;
- to determine time when hot water consumption will start;
- as take for base in-boiler water current temperature, starting heating time to be selected thus that reaching maximum water temperature (i.e., stopping heating process) to synchronize with hot water consumption starting time.

In result of the proposed method the principal functional block-scheme acquires the following appearance:



Where the heater 3, powered by electric main through controller unit 2 heats water up to desired temperature. The essential in this case is that the method, by the controller unit, enables in arbitrary time  $T_2$  (Fig.2) wanted later time  $T_p$  to be fixed, which is start of hot water consumption in such manner that the  $T_1$  time of start of hot water consumption to start when the time  $T_3$  needed for reaching the water temperature defined by the thermal controller to synchronize to the  $T_p$  time, when the hot water will start to be consumed.

As result of this method, enabling of the storage electric boilers to operate in delay mode, the following advantages are effected: the necessity of boiler operation much before time when hot water would be consumed, and as result energy losses would reduced many times, as result of thermal radiation on environment - for comparison (scaled) hatched area  $S_1$  (Fig.1), representing thermal losses of normally operating storage boiler is many times larger than the area  $S_2$  (Fig.2), representing thermal losses of storage boiler operating in delay mode. For both figures equal time periods are considered;

Eliminated are the frequent and unbroken for long periods turns thermocontroller ON/OFF after reaching the maximum water temperature, which increases the reliability and prolongs the boiler's "repair-to-repair" periods;

The energy system is total relieved, as a positive effect is produced and in so-called "peak hours".

#### **BRIEF DESCRIPTION OF THE DRAWINGS.**

As an example for application of the method of control, leading to volumetric storage boiler operation in delay mode, the scheme of Fig.3 could be examined.

#### **EXEMPLARY EMBODIMENTS OF THE INVENTION**

A thermocouple 2, feeding data about current water temperature to the adjustable controller 3, is mounted on the boiler's water reservoir 1. The test lamp 4 lights when voltage is applied by switch 8. On display 5 after pressing the timer button 6 the current time is displayed, and after pressing RESET knob 7 the hot water consumption time is displayed. Minute setting button 9 and the hour setting button 10 provide time setting. On display 11 the boiler water current temperature is displayed.

For explanation of this method we accept the supposition that today the person X would travel to a neighbour town and he would be returned about 13.00 o'clock on next day, when he needed by hot water. In this case, we, in order to apply this method, leading to storage boiler operation delay mode, we shall execute the following procedures by means of the controller unit (Fig.3):

- The display 5 shall be reset by button 7, and desired time, when hot water would be consumed, shall be adjusted by buttons 9 and 10;
- Voltage is applied to the controller by turning on switch 8, then the test light indicator 4 is energized;
- In this position, the controller doesn't feed voltage to the heater 12;
- On the next day only, the controller, receiving by the thermocouple 2 data for boiler water current temperature, shall switch on and apply voltage to the heater in such time that the heating process to finish in 13.00 o'clock. This switch on time and heating duration (usually 1-3 hours) depend very much on residual stored energy from previous boiler turnings on and heater 12 power.

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## PATENT CLAIMS

A method for storage volumetric electric boilers operation control enabling them a possibility to operate in delaying mode, that the storage boilers start the heating process right after applying electric voltage and providing the hot water in un-needed time, to can operate in manner featuring with that heating process is shifted in time in relation to boiler switching on time in such manner that independent on this switching on time, one to finish in the moment when hot water consumption is expected.

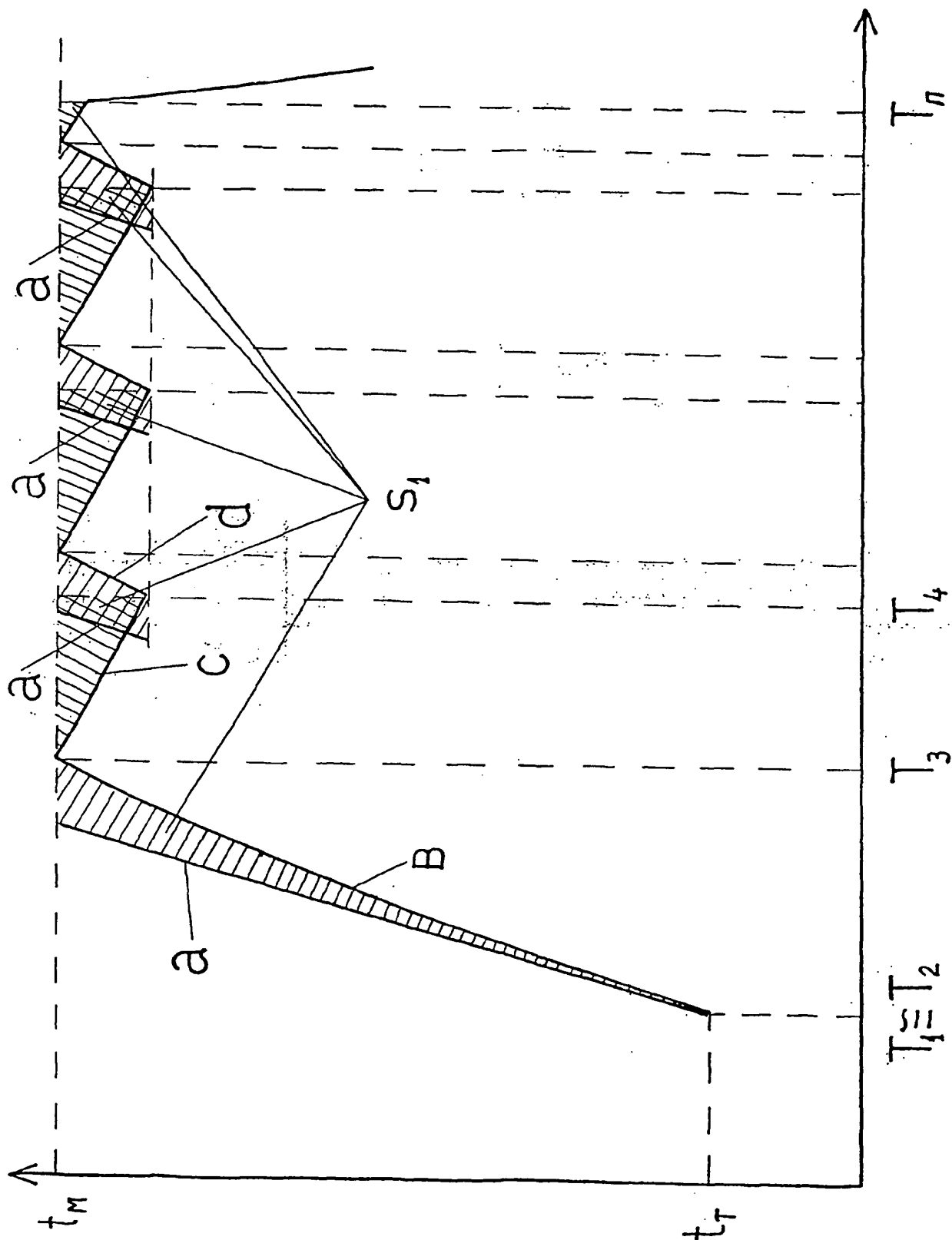


Fig. 1

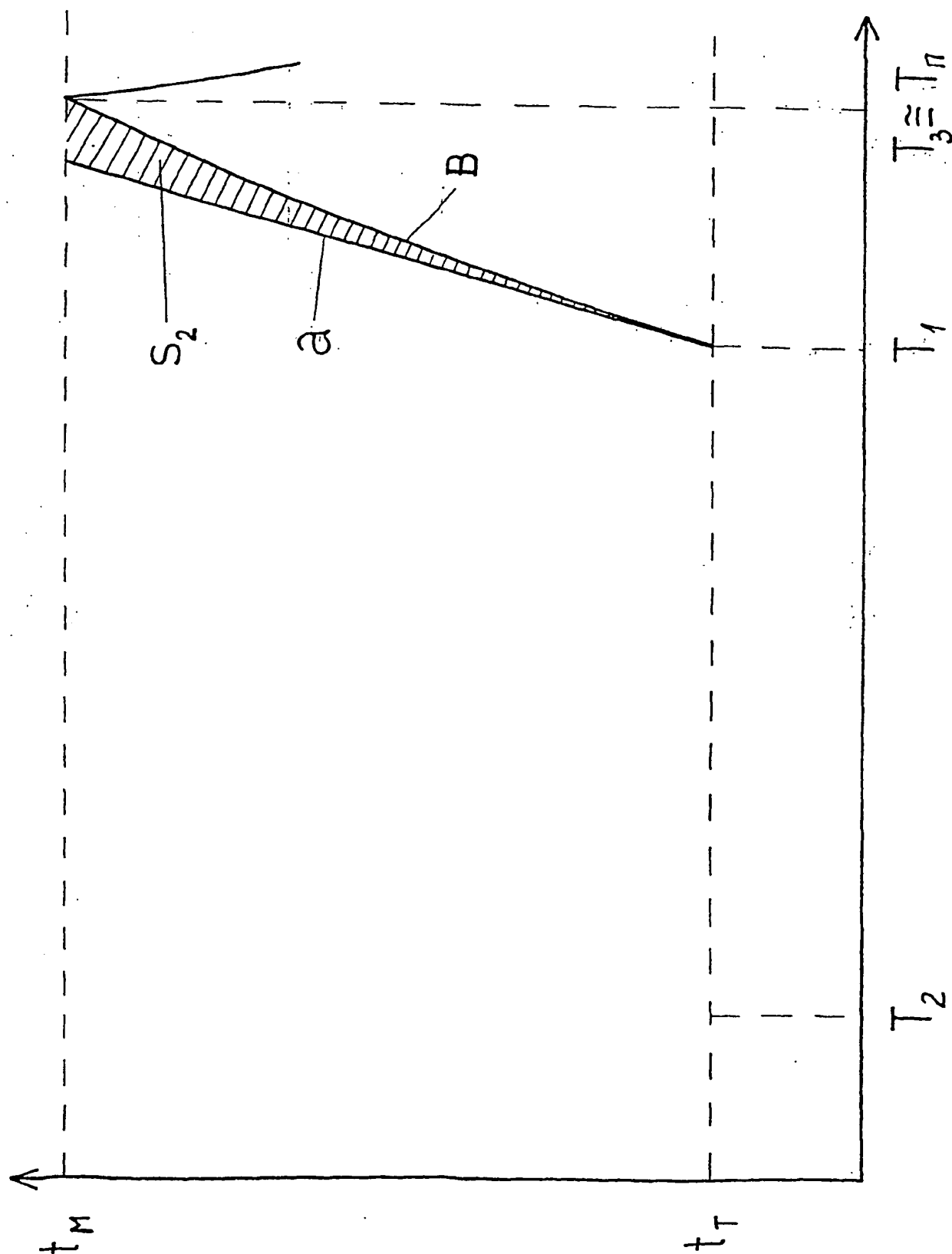
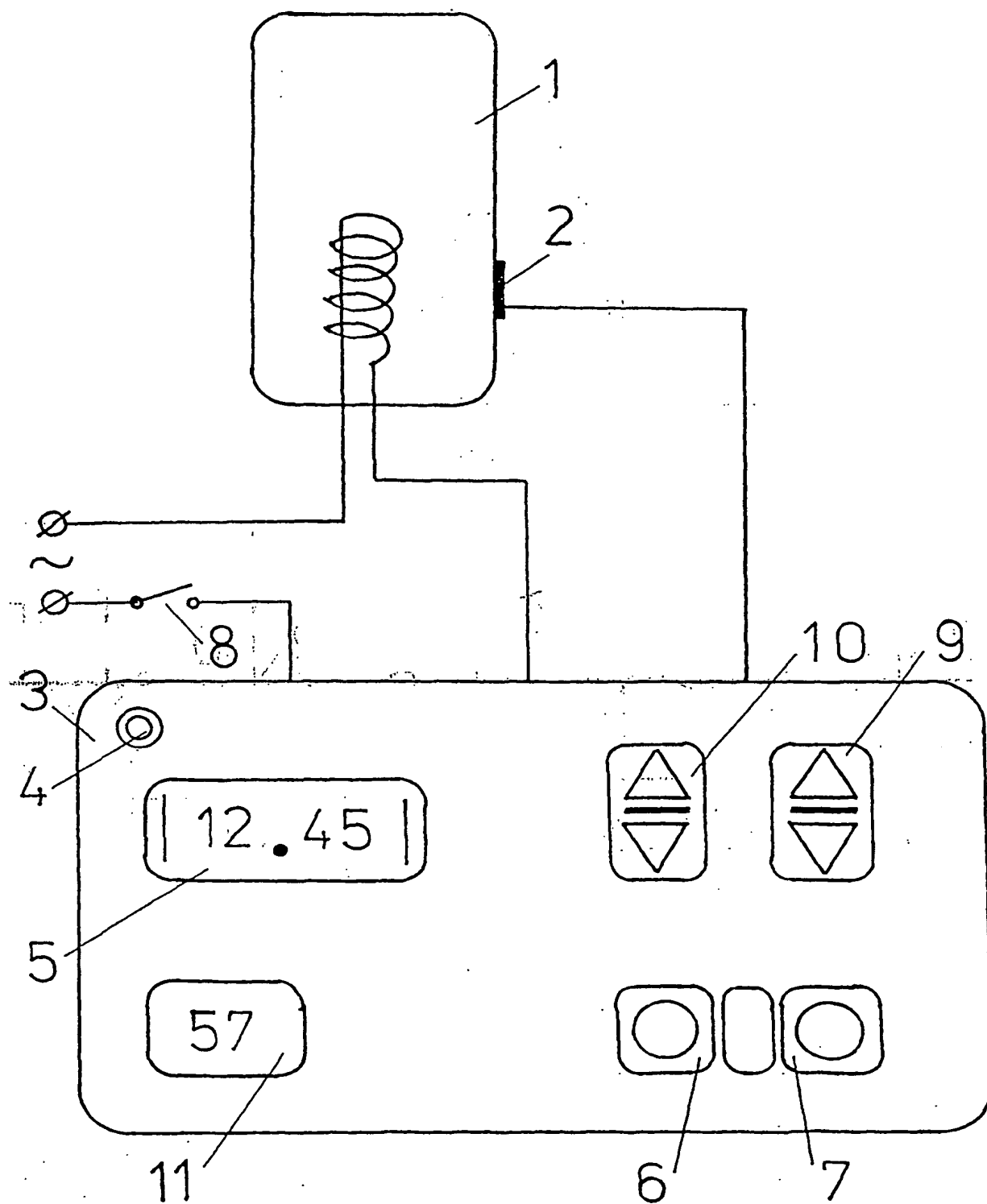


Fig. 2

*Fig . 3*

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International Application No

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## A. CLASSIFICATION OF SUBJECT MATTER

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According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F24H G05D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 171 539 A (DIAMOND H CONTROLS LTD) 28 August 1986 (1986-08-28) abstract	1
X	EP 0 084 614 A (GRAESSLIN FEINWERKTECH) 3 August 1983 (1983-08-03) abstract	1
X	FR 2 465 389 A (RADIOTECHNIQUE COMPELEC) 20 March 1981 (1981-03-20) abstract	1
X	GB 2 203 861 A (HORSTMANN GEAR GROUP LTD) 26 October 1988 (1988-10-26) abstract	1
	-/--	



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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X	DE 34 26 905 A (STIEBEL ELTRON GMBH & CO KG) 30 January 1986 (1986-01-30) abstract -----	1

# INTERNATIONAL SEARCH REPORT

Information on patent family members

onal Application No

PCT/BG 01/00012

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
GB 2171539	A	28-08-1986	NONE	
EP 0084614	A	03-08-1983	DE 3202128 A1 EP 0084614 A1	04-08-1983 03-08-1983
FR 2465389	A	20-03-1981	FR 2465389 A1	20-03-1981
GB 2203861	A	26-10-1988	NONE	
DE 3426905	A	30-01-1986	DE 3426905 A1	30-01-1986

Form PCT/ISA/210 (patent family annex) (July 1992)